# Human capital and its influence on entrepreneurial success

Moog, Petra

*Historical Social Research, Vol. 27 — 2002 — No. 4, 157-180*

# Human Capital and its Influence on Entrepreneurial Success

*Petra Moog*[*]

**Abstract:** The focus of the paper is on human capital as the key factor for the success and growth of a newly founded company. The findings suggest that investments in human capital have significant influence on the growth of start-ups. The results should lead universities, politicians as well as individuals to a better education for potential founders to generate more successful start-ups.
The results are based on survey data for nearly 1.000 German start-ups. The paper analyzes whether higher human capital of the founder leads to higher growth-rates among start-ups. Results show that companies started by a founder who invested heavily in his human capital generate higher growth rates in sales, jobs and income differences than start-ups founded by a less educated individual.

## 1. Introduction

Only a few newly founded companies are really successful: They start small and expand rapidly in a few years. MorphoSys AG for example: The company started in 1992 in Munich with three academic founders and three employees. Today MorphoSys gives 200 employees high qualified and secure jobs and is acting worldwide; the company is well established at the 'New Market' and still on the run for expansion. On the other hand there exist a lot of newly founded enterprises leaving the market as quick as they entered. Moreover many start-ups grow slow - almost stagnating, create only a few jobs, with a minimum of income for the entrepreneur. Analyzing new founded companies it

[*] Address all communications to Petra Moog, Institut für betriebswirtschaftliche Forschung (IfbF) – Zurich University, Switzerland, Plattenstrasse 14, CH – 8032 Zurich, E-mail: petra.moog@ifbf.unizh.ch respectively to Institut für Mittelstandsforschung Bonn, Germany, Maximilianstrasse 20, D – 53111 Bonn.
The project of GrünCol! (= start-ups in Cologne; G*rün*dungen in *Col*ogne) is sponsored by the DFG (German Science Foundation), the DtA (German development agency) and the Cologne Savings Bank.
We thank Jürgen Sensch for helpful support and comments concerning statistical methods.

becomes obvious that the development, growth and success of surviving start-ups are distributed inhomogeneous. The interesting question in this context is: What determines these differences in the success and growth of new firms?

One explanation could be the human capital of the founder(s). So politicians all over the world and especially in Germany hope, that due to the persistent high unemployment rate in the German economy, successful new firms will help overcome the labor market problems and contribute to economic development. This holds particularly for knowledge intensive start-ups: The current academic debate suggests knowledge intensive new companies to be rare but to be an important primary source of new employment and of a renewal of the economic structure, being the engine of economic growth (Joos 1987; Reynolds/Miller/Maki 1995). Since the first research of Birch (1979; 1987) concerning the creation of jobs by new founded firms[1] the current debate and new studies show that the job creation and innovation effects of knowledge intensive new firms are stronger than those of other start-ups (Kulicke 1987; Pett 1993; Nerlinger 1998). Knowledge intensive new firms often result from high educated, academic founders or directly from academic institutions.[2] Particularly Albach (1999) emphasizes in this context that the knowledge from universities and colleges has to be ladled out in a better way for the German economy. Until now for Germany it is widely unknown, how many academic founders exist and moreover whether these academic founders can really satisfy the expectations concerning company success. What is known is that the change in the production regimes and the ongoing service orientation of the economy fostered the importance of quality in businesses and therefore the importance of high qualification – of human capital for successful companies and start-ups (Falk/Koebel 1998: 339). Especially new markets and industries like communication, media or biotechnology increased the requirements on people working in these industries to become successful; accordingly this holds for founders of new companies in these industries to become successful. In former years founders were – like employees, managers and executives – very poor educated[3]: Often they had nor an apprenticeship neither a university degree (Keeble 1992: 39). In these former days it was the type of self-made man like Horatio Alger[4]

---

1 Critical reflecting Birch's studies and results there has been sceptical studies due to the role of start-ups in the labor market (Audretsch 1996, Holtz-Eakin/Joulfaian/Rosen 1994).

2 Already worldwide recognized spectacular success stories of university spin-offs and academic foundations are i.e. in the United States of America the Massachusetts Instititute of Technology (Boston Bank 1998) or Stanford University (Saxenian 1995) and in the United Kingdom the Cambridge University (Sigal, Quince & Partners 1985).

3 In the 1960s a lag of education was blamed among German executives. Today they are well educated. So a structural change in education has to be seen on the long run (Poensgen 1982).

4 Horatio Alger was a so called self-made man, a founder and millionaire who was very successful without any school education – like a lot of other successful businessmen at the beginning of the last century (Holtz-Eakin/Rosen/Weathers 2000:1; 26).

who became self-employed and successful. But in the last decades founders became better educated; on average they are nowadays better educated than employed individuals (Goebel 1990: 126f.; Ripsas 1997: 181).

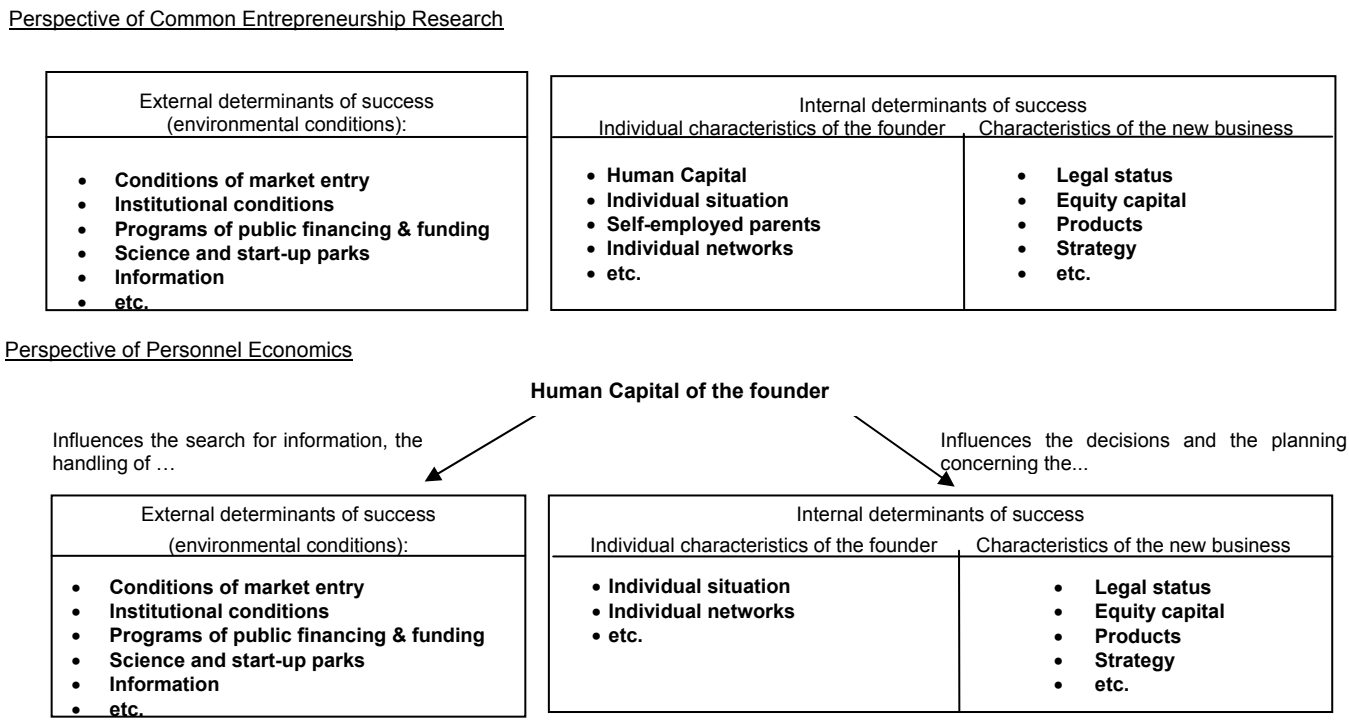
Therefore the purpose of this paper is to analyze the influence of the founder's human capital on the success of his start-up. Success will be measured by growth of quantitative job creation and especially by the number of created jobs which need a high qualification level. The effects of the founder's human capital are examined in descriptive and multivariate analysis. In this context comparisons between academic and non-academic start-ups are carried out. In addition not only the basic effects of human capital are tested but even the interaction effects of different investments in human capital as well as diminishing rates of return and depreciation on human capital investments.

The paper is structured as follows: Chapter 2 briefly summarizes the existing research on success factors for newly founded companies. Chapter 3 discusses the theoretical basis for the empirical model. In chapter 4 the data set is described and the empirical results concerning growth presented. Finally the main results are summed up and conclusions are drawn.

## 2. Recent literature

In the field of entrepreneurship research, a number of authors have analyzed the success factors of start-ups. To explain the success or growth of newly founded companies, authors bundled a lot of different success factors and theoretical approaches in their analysis (like transaction cost theory, resource based view approach, psychological approaches, etc.). Following these analysis of the previous research three major groups of factors affecting the success and growth of new enterprises can be extracted. Storey (1994), Szyperski/Nathusius (1977) or Klandt (1984) named these overriding groups: Personnel success factors of the founder, firm internal factors and firm external factors (see figure 1, first part). Most authors focus on a bunch of factors out of these three overriding groups, concerning for example capital (Schefzyk 2000), legal status (Almus 2000), age of the founder or of the firm, the starting size of the company (Lessat/Woywode 2001), communications and management skills of the founders (Pfeiffer/Reize 2001). But most of these studies still rely on several theories and argue with a lot of different success factors and explaining variables. These studies didn't deliver a key success factor. Moreover studies working with the same four or five theories and the same stes of factors created nevertheless controversial results. It seems by working with different theories in one analysis there is rather a lost of empirical evidence in the analysis to note than representative results.

Figure 1: External and internal determinants of the success of newly founded companies (own depiction)



The explanatory power of using only one theory to explain success and growth – in this case the human capital theory – was until now more or less neglected, even when the question how to explain success and growth differentials of new founded companies looks familiar to the question explaining income differentials of employees. Moreover when success indicators like growth of employment numbers, sales or income differences are used as proxy for the founder's income, the transfer of Becker's human capital theory seems obvious for explaining inequalities in the development of start-ups. But human capital theory has been used rarely for analysis in the entrepreneurial context – at the most as one explaining factor or theory besides a lot of other theories or factors. If studies worked somehow with human capital theory it was only brought into action in rudiments and not in its fully theoretical depth like the overview of recent studies in table 1 shows. This might be a reason why till now the effects of human capital variables in different analysis are often contradictory or inconsistent explaining the success and growth of start-ups.

Table 1: Recent studies analyzing success and growth

| Author | Hinz (1998) | Bates (1990) | Lessat/Woywode (2001) | Almus/Nerlinger (1999) |
|---|---|---|---|---|
| Endogenous Variable | Survival, growth in sales and jobs | Survival | Probability to be one of the fast growing companies | Growth rate in sales and jobs |
| Model | OLS<br><br>Bivariate Probit-Analysis | Logit Model | Probit-Analysis | Bivariate Tobit-Model |
| Results | Branch experience and overall human capital have a slightly positive influence, unemployment negative. Important: Environment, firm specifics. No specific/differentiated human capital variables. No interaction effects. No marginal productivity effects. No depreciation effects. | Education of the founder enhances chances to survive. No specific/differentiated human capital variables. No interaction effects.<br><br>No marginal productivity effects. No depreciation effects. | Strong positive influence by: Age of the founder, legal status, age of the company and founding size, academic degree. Human capital not consistently defined. No specific/differentiated human capital variables. No interaction effects. No marginal productivity effects. No depreciation effects. | Branch or technology, age of the firm, capital interest, legal status significant positive relation to explain the growth rates; human capital not significant. A few specific/differentiated human capital variables, No interaction effects. No marginal productivity effects. No depreciation effects. |

| Author | Pfeiffer/Reize (2001) | Honig (1998) | Brüderl/Preisendörfer /Baumann (1991) sowie Brüderl/Preißendörfer /Ziegler (1996) |
|---|---|---|---|
| Endogenous Variable | Probability to participate on continious vocational training monthly income | Monthly profit (ln) | Death rate and survival, job creation sales |
| Model | Switching Regression Model | OLS Regression-Model | Bivariate estimation: Log-logistic regression and Probit-Analysis 3 Models, but no comparison with the basic model |
| Results | Self-employed individuals have a different training scheme than employees. Training has a stronger influence on income than seniority. No academic founders or employees in the data base .No interaction effects. No marginal productivity effects. No depreciation effects. | Environment, social networks, branch experience and College education have a significant positive influence. No interaction effects. No marginal productivity effects. No depreciation effects. | Self-employment of the father, firm specific and environmental characteristics have significant influence. The used human capital variables have indifferent effects: strongly positive for survival, for job creation and sales no influence was measured. Human capital not consistently defined. No interaction effects. A few marginal productivity and depreciation effects. |

This fact opens a research gap, this project wants to fill by:

- differentiating general and specific human capital in the context of entrepreneurial success
- analyzing the heterogeneous endowment of company founders with human capital
- analyzing marginal productivity effects of human capital investments
- acknowledgement of depreciation effects of investments in human capital

- measuring interaction effects of investments in human capital
- analyzing success, measured in growth of job creation (quantitative and qualitative), sales, and income differences.

To answer these questions and to fill this research gap, in the next chapter the theory of human capital will be explained and transferred to the entrepreneurial context.

# 3. The theoretical framework

The basic theoretical idea behind the empirical analysis is Becker's human capital Theory (Becker 1962; 1993/1964).

## 3.1 General ideas of human capital theory and hypothesis

Like Becker and other authors have shown for employees with high empirical evidence even founders and self-employed can earn higher incomes in later periods when they invest in prior periods in their human capital. Moreover human capital theory offers already for established companies an accepted approach explaining a companies' success (Backes-Gellner/Freund/Kay/ Kranzusch 2000): "The human capital (of employees) is because of its qualifications, its enormous powerfulness, and its loyalty to a firm regarded as the fundamental element for a company's success" (Nagel 1997). Or: "Intellectual capital is the essential constituent for success" (Milius 2000). The first argument in combination with the latter one makes it reasonable to transfer the human capital theory on entrepreneurship research to explain the success and growth of newly founded companies. Moreover this transfer seems appropriate because especially the human capital of a founder, who's capacity for work particularly flows into his own founded company, constitutes the success of his new firm. This holds even more when the founder represents the dispositive factor of a new enterprise, especially if the company is an original foundation[5] like in the present analysis.

So this paper elaborates on the mechanisms how human capital and the accumulated investments in knowledge enhance the success of self-employed and the growth of their business start-ups. Especially the influence of the highest education level (i.e. university or college studies) on the company's success and growth will be analyzed. The human capital theory offers a comprehensive set of factors which on the one hand directly explain the success of a new

[5] An original founded firm must be newly founded and independent - without a prior structure or existence (Szyperski/ Nathusius 1977).

founded firm and on the other hand influence other common success factors as shown in figure 1 (part two).
Following the general ideas of human capital theory the hypothesis of this paper is put forward (see also figure 2):
*An entrepreneur invests in prior periods in his human capital to increase his productivity and by doing so he will reach in future periods a higher income by being more successful than other less educated entrepreneurs.*

Figure 2: The human capital approach in the context of entrepreneurship


Source: Own graph, following Cohn/Geske (1990).

The entrepreneur with a higher amount of human capital is more productive or efficient in organizing and managing the internal and external firm processes. A founder, who is better educated or has accumulated more human capital is more efficient in getting, evaluating and utilizing information and contacts, he is more effective to get money from banks and investors or venture capitalists (Pfeiffer/Falk 1999). He often has already more personal financial capital which he can invest in the company because of his former job-income (Bates 1990). He will easier recognize the niches and branches of industry where he may have better chances to enter the market and to gain profits. He knows he can raise his amount of human capital by founding the company in a team and doing so being more successful. Therefore a founder with an academic education should be more successful than other founders.

## 3.2 Profound analysis with human capital theory

Becker's human capital theory distinguishes between general and specific human capital (Machlup 1984). In this paper at first the common measures of general human capital like years of formal schooling, years of apprenticeship, years of higher education and of vocational training are investigated. To start in a team[6], to have self-employed parents as well as former practical experiences as an employee or as a self-employed are defined as informal human capital

[6] To gain kind of economies of scope educated founders start their business often in teams: in this case the investment are the searching and transaction costs, so the human capital effect of a team foundation will be tested in the latter model.

investments. These investments still count as general human capital. The years of branch experience or first practical knowledge as a self-employed cannot be defined as specific human capital like some prior studies do (Wanzenböck 1998, Gimeno/Folta/Cooper/Woo 1997, Brüderl et al. 1992, 1996). If these latter investments and experiences would be taken as specific human capital this wouldn't be conform to Becker's theoretical assumptions: General skills are useful in different kinds of jobs. They increase the marginal productivity of an individual working as a dependent employee as well as a self-employed in any kind of job. Therefore founders are willing to pay the costs for general training and investments by their own. In contrary, specific training increases productivity in the institution providing it, only. It has no effect on the productivity of the trainees at other workplaces. The surplus is divided by both – the employer and the employee. Therefore individuals are sharing the costs for specific training with the company providing it. This idea is not applicable to the training and generated skills of an entrepreneur. Therefore the following analysis is based on general human capital. The effects of formal education of the founder on the growth of his start-up will be discussed in a basis model, the influence of investments in informal human capital will be analyzed in a second model (see chapter 4.2.2).

But human capital theory not only offers explaining variables concerning the investments in formal and informal education. Even the marginal rate of return of investments in human capital is regarded, for example the effect of a further investment in education (second apprenticeship, second university degree, etc.). This idea of a concave income profile does matter a lot in the human capital discussion. In case of a too long investment period in human capital the marginal value of an investment decreases per unit invested. Moreover such an investment might not generate enough return, because the time left to generate returns is too short compared to the investment period. Following this argument and transferring it in the entrepreneurial context, it is a negative effect on growth and success expected. Moreover effects of depreciation of investments are discussed in the human capital theoretical framework. Accordingly in a third model this paper will discuss the depreciation effects (i.e. by unemployment before starting the company) of human capital.

Beyond the basic (additive) effects of general human capital investments on success and growth of newly founded businesses, complementarities between the different kinds of investments in human capital are analyzed as well, tested as interaction effects (Hamermesh 1999). Interaction effects measure how the appearance of one factor or variable (mastership for example) specifies and influences the effect of another variable (i.e. university education) on growth. By multiplying a metric and a bivariate variable these differentiating effects can be analyzed (Aiken/West 1991: 10f., Thome 1991: 31f., Fox 1997: 388, 391f.). It is expected that these interaction effects will positive influence the success and growth of start-ups. To test the hypothesis and the impact of differ-

ent human capital variables a survey was generated which is described in the next chapter.

# 4. Data, variables, method, and empirical results

## 4.1 The data set

The company data set used for the empirical analysis is drawn from our survey - GrünCol!. From a total of nearly 50.000 start-up registrations, founded from 1992-1998, there has been drawn a stratified random sample of business addresses. These start-ups include not only businesses administered by the Chamber of Commerce but also crafts, physicians, architects, and lawyers. 17.895 founders got a questionnaire by mail. The data set includes 910 responses (5,1%).

Table 2: The Data Set

| Design | Company survey |
|---|---|
| Data Mining | Standardized mail survey |
| Sampling | Stratified random sample,<br>cross section analysis |
| Pretest | Yes |
| Send outs | 17.895 |
| Data bases | 54.004 |
| Questionnaire | 6 pages |
| Incentives to participate | Offer to send a first descriptive analysis |

## 4.2 The Variables

### *4.2.1 The dependent variable: Growth*

The hypothesis, that human capital of the founder, especially university education, will lead to higher success and growth of a start-up, will be tested in a multiple regression model (Ordinary Least Squares OLS-Regression).

Overall the success of young firms can be measured and evaluated in many different ways (Sexton/Pricer/Nenide 2000; Davidsson 1989). Reliable indicators for success are: Growth of sales and employment, profit, ROI, increase of the shares value, personal income, number of innovations or patents a firm develops and generates and last but not least the absolute number of created jobs.

All these success indicators have individual advantages and disadvantages. Common to work with are growth in sales and employment. So in the overall project a bundle of success indicators is checked and it can be shown that growth in sales, income differences and employment are strongly correlated (see table 3). This means if sales do increase growth, the growth of created jobs and income differences will rise, too.

Table 3: Correlation of success indicators:
Sales, income differences and job creation

| | | Job Creation | Income differences | Sales |
|---|---|---|---|---|
| Job creation | Pearson correlation | 1,000 | 0,133 | 0,535 |
| | S | , | 0,008** | 0,002** |
| Income differences | Pearson correlation | | 1,000 | 0,291 |
| | S | | , | 0,015* |
| Sales | Pearson correlation | | | 1,000 |
| | S | | | , |

Notes: ** Statistically significant (two-tailed tests) at the 0,01 level.
* Statistically significant (two-tailed tests) at the 0,05 level.
Source: Own data - GrünCol! 2002.

But the crucial dependent variable tested in this paper is job creation: General job creation and especially created high qualified jobs. The latter variable to test is even more interesting because only a few prior studies have been examining qualitative differences in the created jobs of new start-ups (Ferligoj/Prašnikar/Jordan 1997). In this paper only these two success indicator will be investigated. But why should the number of created qualified jobs be an indicator for success of a start-up? - A stringent human capital oriented explanation why particularly best educated founders should gain more jobs being successful is given by Murphy/Shleifer/Vishny (1991). They argue that best educated people try to be entrepreneur to organize the production through others und by acting so to bring in their human capital more efficiently as in a dependent job so they can increase their income: "… the abler expand the size of the firm so they can spread their human capital advantage over a larger scale…" (Murphy/Shleifer/Vishny 1991). So the better educated a founder is the greater is his interest to create more jobs. Following the same argument it makes sense that best educated founders are even more interested to create high qualified jobs for educated people to use cascade effects of their human capital and to get economies of scales of their knowledge in the newly founded firm

(Rosen 1982 and 1988)[7]. So best educated founders employ more high qualified people to increase their own profitability and success.
Growth in general is measured by the term:

$$G_i = \frac{\ln A_{ti1997} - \ln A_{tiF}}{(t_{i1997} - t_{iF})}$$

The growth rate of the variables between two time intervals $t_{i1997}$ and $t_{iF}$ (F = year of foundation) is calculated as the difference between these two points in time of i.e. the number of employees after taking logs. This difference is divided by the length of the time interval. The term implicitly assumes an exponential growth path that is fairly standard economic assumption. Taking logs an OLS regression is still applicable.

### *4.2.2 The explanatory variables*

Due to the hypothesis there will be only explanatory right-hand variables based on human capital theory. These predictors are listed in table 4. There are control variables as age of the company, the size of the firm when starting, the gender of the founder as well as the branch the start-up is working accordingly to the ceteris-paribus premise.

According to the theoretical approach the predictors of entrepreneurial growth are put into a modified Mincer income function (Mincer 1974; 1993), type semi-log. To make the four-step-regression models easier to handle, the independent variables were organized in vectors. These vectors represent the different model specifications explained in table 4, where different human capital variables form one vector. The analysis is started with the basic estimation

Table 4: The explanatory variables

| Vector | Variable | Meaning of variables | Measurement | |
|---|---|---|---|---|
| FORMHC: FORMAL HUMAN CAPITAL | SCHULE | School education | Yes = 1 / No = 0 | Dichotomous |
| | BERUF | Apprenticeship | Yes = 1 / No = 0 | Dichotomous |
| | MEISTER | Mastership | Yes = 1 / No = 0 | Dichotomous |

[7] For example a professional in biotechnology: This specialist will be more successful as a founder when he creates qualified jobs, because high qualified employees can work with his knowledge (i.e. creating new products or solutions with his idea), so his knowledge is spread on a larger scale than only working by himself or with lower educated employees.

| Vector | Variable | Meaning of variables | Measurement | |
|---|---|---|---|---|
| | HOCHSCHU | University education (including PhD and tenure track) | Years | Metric |
| INFORMHC: INFORMAL HUMAN CAPITAL | PRAXIS | Work experience in the industry of the start-up | Years | Metric |
| | TEAM | Team foundation | Yes = 1 / No = 0 | Dichoto-mous |
| | VORSELB | Prior self-employment | Yes = 1 / No = 0 | Dichoto-mous |
| | ELTERN | Self-employed parents | Yes = 1 / No = 0 | Dichoto-mous |
| DEGRESSHC: DEGRESSIVE HUMAN CAPI-TAL –EFFECTS | HOCHHOCH | Years at university (squared) | Years | Metric |
| | PRAXPRAX | Years of practical experience (squared) | Years | Metric |
| | ARBEITSLOS | Prior unemployment | Yes = 1 / No = 0 | Dichoto-mous |
| INTERACT: INTER-ACTION EFFECTS | BERUFHS | Interaction effect of university education and apprenticeship | Years | Metric |
| | MEISTERHS | Interaction effect of university education and mastership | Years | Metric |
| | PRAXISHS | Interaction effect of university education and practical experience | Years | Metric |
| CONTROL: CONTROL VARIABLES | SEX | Gender | Yes = 1 / No = 0 | Dichoto-mous |
| | AGE | Age of the start-up | Years | Metric |
| | PERSOGRÜ | Employees at time of foundation | Number | Metric |
| | KAPITAL | Capital invested at foundation | In DM (1.000) | Metric |
| | DUMMY-VARIABLES (INDUSTRIES): BAU, VE-RARBEI, HANDEL, VERKEHRDL, UNAHEDL, PERSODL, SONSTIGE<br>REFERENCE CATEGORY: VERKEHR/NACHRICH-TENDIENST | | Yes = 1 / No = 0 | Dichoto-mous |

regarding only formal human capital; this basic model is than extended in three steps to test the effects of formal and informal human capital investments, the depreciation effect and synergy effects:

Model - Specifications:

$\log Y = \alpha + \beta_1 \text{FormHC} + \beta_2 \text{Control} + \varepsilon$

$$\log Y = \alpha + \beta_1 \text{FormHC} + \beta_2 \text{InformHC} + \beta_3 \text{Control} + \varepsilon$$
$$\log Y = \alpha + \beta_1 \text{FormHC} + \beta_2 \text{InformHC} + \beta_3 \text{DegressHC} + \beta_4 \text{Control} + \varepsilon$$
$$\log Y = \alpha + \beta_1 \text{FormHC} + \beta_2 \text{InformHC} + \beta_3 \text{DegressHC} + \beta_4 \text{InterAct} + \beta_5 \text{Control} + \varepsilon$$

with logY representing the dependent growth variable, $\alpha$ a constant, $\beta_i$ the regression coefficients of the independent variables and $\varepsilon$ the random or error term.
Accordingly to the step-wise estimations the impact of the determinants will be discussed in detail.

## 4.3 Descriptive results

First descriptive results indicate that academic founders start with more capital, especially equity capital, use more different information before and during the foundation of the firm and that better educated founders do not enter a price-taker market, because they know the disadvantages of such a market. They start their business in branches and niches where quality and innovation of products and services are required. The academic founders say, that their analytical knowledge they got during their education is most helpful. But there can also be recognized a lack of business knowledge which the academic founders tried to extinguish by getting external information and consultancy. These results give a first indication to the higher productivity better educated founders have compared to other founders.

Looking on the descriptive results concerning success indicators like growth of general employment and qualified jobs in particular, it can be seen, that academic founders create more and better jobs: Half of the newly founded companies started with employees – independently whether the founders studied or not. This distribution corresponds to the overall German founding conduct[8].

All (original) start-ups started overall with 1.202 employees. Comparing academic and non-academic foundations they start on different employment levels: Academic founders on average with 1,9 employees, non-academic founders instead with 3,84 employees. Until 1997 academic founders increased their employment status on average up to 7,34 employees per start-up, the non-academic founders only up to 6,57 employees.[9] So the academic founders increase their stock on employment over the time twice as strong as the other founders. Concerning the age of the companies this effect becomes even stronger: The longer a start-up survives the more jobs academic founders cre-

[8] Similar results by Leicht/Philipp (1999:1). Compared to most of the other European countries that's a high share, because there on average only a quarter of start-ups start with employees.

[9] The increase of number of employees per company and year is measured for the period from founding till 1997. Only the development of companies founded from 1992 till 1996 take part in the analysis because only for these differentials are possible to measure over the time till 1997.

ate. For example: An academic start-up founded in 1992 creates until 1997 on average 4,1 jobs per year instead a non-academic company only 1,4 jobs. This effect becomes weaker the younger a company is: I.e. for the youngest start-ups – founded in 1996 – the non-academic founders have a higher job-creation in the first year (1,4 to 1,2 employees per year and company). One reason for this latter result might be, that academic start-ups wait until their successful market establishment before they increase their demand for new employees. Another reason could be that academic start-ups are founded in a company oriented service industry, where in general companies start smaller and grow on the long run (Leicht/Philipp 1999:4).

Looking on the job effects of the analyzed start-ups from a qualitative perspective another positive effect of academic or knowledge intensive foundations becomes obvious: Academic start-ups create on average four times as much jobs for other academics than non-academic foundations. One explanation provides the former cited theoretical model concerning human capital, economies of scales and cascade effects. Moreover academic founders employ twice as much student workers than other founders; on the one hand because they know the quality of these 'workers' and on the other hand they can recruit at an early point high qualified employees. Academic founders create more jobs for low qualified employees than non-academic founders. Academic and non-academic start-ups offer at a similar level vocational training positions.

## 4.4 Empirical results

Analyzing the effect of human capital investments by the founder on the success of his start-up two multiple regressions will be discussed. On a significant level it can be shown that founders with an academic back-round started their businesses more successful concerning the creation of jobs in general and qualified jobs in special.

In this first regression the growth of number of employees is analyzed. Looking at the first model specification it can be shown that visiting and finishing school has a significant impact on the growth of employment. Every year the growth rate of employment will increase by 6 % if the founder visited and finished school. Whether the founder did an apprenticeship or not does not matter on a significant level. The same negative influence can be observed concerning the mastership a founder invested in. In the first model, the basic model, this is not a highly significant determinant of growth. Instead in the other three models this negative influence on job creation and growth becomes significant at a low level. Typically craftsmen want to open their own business but will stay small instead of becoming a large company – this might be an explanation for this result (there are exceptions like Kamps AG). If the founder studied at a university, one year of studying increases the growth of employment per year by 9 % in the basic model. This effect gets stronger as more pre-

dictors come into the model, especially when the depreciation effects and the synergy effects are analyzed. Taking into account only these formal human capital variables the model explains already 26,6% of the variance of the employment growth rate.

The second model focuses on the influence of informal human capital variables. They only provide a small substantial contribution to explain the proportion if variance of employment growth. I.e. years invested in practical experience doesn't raise the growth of employment, nor if the founder has self-employed parents. This might be different and more positive if a founder takes over the company of his family. To found the company in a team elevates the growth rate of employees per year by 28 %. If the founder had been self-employed before founding the current start-up, the growth rate is also positive affected – by 19,3 % per year in the basic model. That might be because the founder has experiences which endorse the creation of jobs. He might know - like team founders - that delegating tasks and assignments can be productive and foster the companies' success.

The implementation of the depreciation and marginal productivity variables intensifies the explanatory power of the estimation. There is always a negative effect on growth by all three variables. Especially the negative influence on success of studying too long or working too many years as an employee in the industry can be shown to be statistically significant determinant. Besides the effects of the new variables by their own the admission of these variables in the model influences the other variables in some way: The influence of years spent in university is doubled may be because in this model all the positive and negative effects of studying are documented. In return the effect of a former self-employed experience is diminished.

The analysis of synergy effects from investments in different educations and their impact on growth show always a positive impact on growth. But only the effect of investing in studying and in a mastership or in practical experience and a university degree are significant predictors for the growth rate of general employment. Finishing an apprenticeship and than having studied doesn't increase job creation statistically significant. So it could be that the more specialized information a founder got out of his experiences in an industry by working there as employee or craftsmen the more the analytical knowledge he got out of studying is valuable.

Regression 1: Growth of employment

| | Model-Specifications | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| Exogenous variables | B (T-Value) | Beta | B (T-Value) | Beta | B (T- Value) | Beta | B (T- Value) | Beta |
| SCHULE | 0,063+ (1,210) | 0,051 | 0,066+ (1,250) | 0,054 | 0,069+ (1,267) | 0,056 | 0,070+ (1,272) | 0,056 |
| BERUF | -0,280 (-0,442) | -0,020 | -0,473 (-0,721) | -0,033 | -0,369 (-0,553) | -0,026 | 0,020 (0,023) | 0,001 |
| MEISTER | -0,120 (-1,128) | -0,050 | -0,148+ (-1,335) | -0,060 | -0,135+ (-1,296) | -0,055 | -0,112 (-0,917) | -0,045 |
| HOCHSCHU | 0,091* (1,864) | 0,141 | 0,065+ (1,598) | 0,129 | 0,186* (1,872) | 0,182 | 0,240* (1,834) | 0,105 |
| PRAXIS | | | -0,006 (-0,169) | -0,007 | 0,0309 (0,294) | 0,033 | 0,011 (0,092) | 0,012 |
| TEAM | | | 0,288+ (1,527) | 0,021 | 0,318+ (1,576) | 0,023 | 0,317+ (1,568) | 0,023 |
| VORSELB | | | 0,193+ (1,333) | 0,013 | 0,085 (1,144) | 0,006 | 0,067 (1,112) | 0,005 |
| ELTERN | | | 0,367 (0,657) | 0,026 | 0,380 (0,676) | 0,027 | 0,384 (0,680) | 0,027 |
| HOCHHOCH | | | | | -0,016+ (-1,661) | -0,056 | -0,020+ (-1,760) | -0,073 |
| PRAXPRAX | | | | | -0,001+ (-1,340) | -0,038 | -0,001+ (-1,248) | -0,030 |
| ARBEIT-SLOS | | | | | -0,573 (-0,805) | -0,033 | -0,598 (-0,835) | -0,035 |
| BERUFHS | | | | | | | 0,184 (0,684) | 0,037 |
| MEISTERHS | | | | | | | 0,064+ (1,252) | 0,010 |
| PRAXISHS | | | | | | | 0,061+ (1,392) | 0,023 |
| SEX | 0,299* (2,430) | 0,316 | 0,560 (0,805) | 0,032 | 0,512 (0,728) | 0,029 | 0,508 (0,720) | 0,029 |
| ALTER | -0,069+ (-1,971) | -0,263 | 0,061 (0,320) | 0,013 | 0,065* (0,340) | 0,014 | 0,057 (0,294) | 0,012 |
| PERSOGRÜ | 0,605*** (17,886) | 0,698 | 0,629*** (17,802) | 0,709 | 0,630*** (17,748) | 0,710 | 0,629*** (17,630) | 0,709 |
| KAPITAL | -0,000001 (-0,425) | -0,016 | -0,000007 (-0,153) | -0,006 | -0,000004 (-0,096) | -0,004 | -0,0000003 (0,082) | -0,003 |
| BAU | 0,365* (2,089) | 0,115 | 0,257 (1,407) | 0,078 | 0,238 (1,295) | 0,073 | 0,228 (1,219) | 0,070 |
| VERARBEI | -0,329* (-2,136) | -0,136 | -0,253+ (-1,577) | -0,101 | -0,233+ (-1,445) | -0,094 | -0,240+ (-1,481) | -0,096 |
| HANDEL | 0,117 (0,842) | 0,067 | 0,316 (0,220) | 0,018 | 0,208 (0,144) | 0,012 | 0,183 (0,126) | 0,010 |
| U NAHEDL | 0,295** (2,247) | 0,226 | 0,203+ (1,491) | 0,153 | 0,199+ (1,458) | 0,150 | 0,202+ (1,463) | 0,152 |
| PERSODL | 0,281* (2,053) | 0,179 | 0,190+ (1,346) | 0,121 | 0,181+ (1,271) | 0,114 | 0,189+ (1,267) | 0,115 |
| SONSTIGE | -0,396+ (-1,603) | -0,077 | -0,488* (-1,935) | -0,095 | -0,490* (-1,931) | -0,095 | -0,491* (-1,928) | -0,096 |
| Model-Fit | $R^2$ (adj.) = 0,266; F=23,893*** | | $R^2$ (adj.) = 0,269 F=18,810*** | | $R^2$ (adj.) = 0,278 F=16,100*** | | $R^2$ (adj.) = 0,289 F=14,024*** | |

Source: Own data - GrünCol! 2002.

(*** significant at 0,000 level; ** significant at 0,01 level; * significant at 0,05 level; + significant at 0,1 level)

The variable the second regression wants to explain is the growth of high-qualified employment compared to the overall growth of employment. Overall the estimation explains the development of high qualified jobs in start-ups at a highly significant level. Each extension of the basic model by more predictors

Regression 2: Growth: share of qualified jobs on all jobs

| | Model-Specifications | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| Exogenous variables | B (T-Value) | Beta | B (T-Value) | Beta | B (T-Value) | Beta | B (T- Value) | Beta |
| SCHULE | 0,118 (0,367) | 0,017 | 0,225 (0,687) | 0,033 | 0,187 (0,557) | 0,027 | 0,172 (0,510) | 0,025 |
| BERUF | -0,213*** (-5,449) | -0,274 | -0,208*** (-5,179) | -0,265 | -0,201*** (-4,948) | -0,257 | -0,236*** (-4,379) | -0, 301 |
| MEISTER | -0,277*** (-4,210) | -0,205 | -0,254*** (-3,738) | -0,187 | -0,237*** (-3,436) | -0,174 | -0,263*** (-3,551) | -0,193 |
| HOCHSCHU | 0,037*** (5,715) | 0,296 | 0,040*** (5,953) | 0,318 | 0,056*** (4,344) | 0,449 | 0,045** (2,562) | 0,356 |
| PRAXIS | | | 0,003+ (1,380) | 0,063 | 0,005+ (1,897) | 0,111 | 0,003+ (1,507) | 0,073 |
| TEAM | | | 0,021+ (1,650) | 0,029 | 0,017+ (1,523) | 0,023 | 0,018+ (1,546) | 0,025 |
| VORSELB | | | 0,082* (2,324) | 0,102 | 0,078* (2,154) | 0,097 | 0,077* (2,115) | 0,096 |
| ELTERN | | | -0,042 (-1,239) | -0,054 | -0,038 (-1,131) | -0,050 | -0,038 (-1,104) | -0,049 |
| HOCHHOCH | | | | | -0,002+ (-1,447) | -0,136 | -0,001 (-0,827) | -0,087 |
| PRAX-PRAX | | | | | -0,0001+ (-1,432) | -0,054 | -0,00006+ (-1,229) | -0,030 |
| ARBEIT-SLOS | | | | | -0,020+ (-1,470) | -0,021 | -0,019+ (-1,435) | -0,020 |
| BERUFHS | | | | | | | 0,015** (2,962) | 0,058 |
| MEIS-TERHS | | | | | | | 0,078** (2,502) | 0,023 |
| PRAX-ISHS | | | | | | | 0,003* (2,375) | 0,024 |
| SEX | -0,018 (-0,285) | -0,012 | -0,006 (-0,159) | -0,007 | -0,012 (-0,297) | -0,013 | -0,012 (-0,291) | -0,013 |
| ALTER | -0,034** (-3,015) | -0,130 | -0,035** (-2,992) | -0,130 | -0,035** (-2,985) | -0,130 | -0,035** (-3,014) | -0,133 |
| PERSO-GRÜ | -0,006** (-3,008) | -0,130 | -0,007*** (-3,253) | -0,143 | -0,007*** (-3,302) | -0,145 | -0,007** (-3,220) | -0,143 |
| KAPITAL | 0,0000001 (0,016) | 0,381 | 0,0000002 (0,102) | 0,005 | 0,0000003 (0,138) | 0,006 | 0,0000006 (0,224) | 0,010 |
| BAU | 0,002 (0,019) | 0,001 | 0,005 (0,046) | 0,003 | -0,007 (-0,067) | -0,004 | -0,020 (-0,177) | -0,011 |
| VERARBEI | -0,099 (-1,045) | -0,073 | -0,105+ (-1,517) | -0,074 | -0,111 (-1,116) | -0,079 | -0,115 (-1,153) | -0,082 |
| HANDEL | 0,035 | 0,036 | 0,034 | 0,036 | 0,034 | 0,035 | 0,031 | 0,032 |

| | Model-Specifications | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | (0,412) | | (0,395) | | (0,391) | | (0,353) | |
| U NAHEDL | 0,111+ (1,373) | 0,152 | 0,127+ (1,517) | 0,171 | 0,122+ (1,459) | 0,165 | 0,115+ (1,369) | 0,156 |
| PERSODL | -0,005 (-0,066) | -0,006 | -0,009 (-0,115) | -0,011 | -0,005 (-0,059) | -0,006 | -0,002 (-0,025) | -0,003 |
| SONSTIGE | 0,030 (0,197) | 0,010 | 0,011 (0,074) | 0,004 | 0,011 (0,075) | 0,004 | 0,009 (0,064) | 0,003 |
| MODEL-FIT | $R^2$ (korr.) = 0,353; F=15,273*** | | $R^2$ (korr.) = 0,361 F=12,145*** | | $R^2$ (korr.) = 0,398 F=10,512*** | | $R^2$ (korr.) = 0,401 F=9,200*** | |

Source: Own data - GrünCol! 2002.
(*** significant at 0,000 level; ** significant at 0,01 level; * significant at 0,05 level; + significant at 0,1 level)

increases the explanatory power of the model as can be seen by the steady increase of the adjusted R-square[10] per specification from 35,3 % in the basic model up to 40,1% in model 4.

In the basic model the analysis of the standardized β-coefficients shows that school education does have a positive influence on the creation of high-qualified jobs but at a non-significant level (this counts for all models). School creates the basis for all further investments in human capital. But this important general influence is in great parts covered by other investments in human capital. I.e. if the founder has finished an apprenticeship or a mastership the yearly increase of shares of highly qualified jobs on all jobs is diminished by 21 % for apprenticeship and 27,7% for mastership. This influence takes place on a highly significant level. This might be because founders with a mastership or apprenticeship rarely employ mangers and academics in leading positions because they lead the company by their own. Often they don't need high qualified people in the production process. Only sometimes, depending on the size of the company or the intenseness of research and development, they really need academics or highly qualified employees. Investments in an academic education show significant effects on the creation and growth of qualified jobs. If a founder invests one more year in his academic education the share of highly qualified employees on all employees in a start-up increases by 3 % per year and company.

Inserting the four informal human capital variables in model 2, only the parental entrepreneurship activity doesn't increase the growth of highly qualified jobs (not at a significant level). Practical experience in the industry, team foundation and a former self-employment experience enhance the growth rate of qualified jobs at a significant level. Compared to the general job creation practical experience in this case might give the founder the knowledge to employ qualified people to make the business run and successful. The same argument holds for former self-employed. In a team foundation the team members know

[10] The regular R-square indicates the proportion of variance explained by the variables in the equation; the adjusted R-square measures this corrected by the number of new variables in the model (Bühl/Zöfel 2000:336).

their deficits so they know the need of other specialist to enhance their productivity and success[11].

In model three the marginal productivity and depreciation effects of human capital investments are tested. All three have a statistically significant negative impact on the success indicator growth and affirm the effects of the formal and informal human capital variables. This estimation produces a significantly better adjusted R-square for the overall model.

In the last step the interaction effects between different investments in human capital are measured. All 'double investments' show positive effects in start-ups on the growth of the share of qualified jobs on the general employment. As opposed to the results in the first regression this time the synergy of different investments in human capital significantly enhances the growth of the share of qualified jobs on the general employment. Moreover even the founders who did an apprenticeship and studied at a university do now increase the share of high qualified employees. In all three cases it might be, that the founders know – because of their double qualification - about the positive effect of another specialist or qualified employee in a company: To discuss a problem, to think about problem solutions or to delegate tasks to someone who can manage this challenge. Again: The interaction of practical experience during an apprenticeship, a mastership or working as an employee and the analytical and theoretical knowledge from university seems to generate a higher output than investing too much in only one education. So the most successful entrepreneurs are those who invested in theoretical and practical knowledge.

## 5. Concluding comments

It could be shown that founders with an academic back-round started their businesses more successful concerning the creation of jobs in general and qualified jobs in special. The most successful start-ups were those where the founders had both, invested in a theoretical back-round (may be to generate the innovative idea for a start-up) and did invest in practical experience. To generate more successful start-ups German politicians should be aware, that best educated founders are the most successful ones in creating jobs and innovations, gaining sales and profit on a long term.

But academic founders need on the one hand a better education concerning entrepreneurial or business knowledge. On the other hand students should be aware of the chances (and problems) by starting their own company. Therefore it might be reasonable to offer entrepreneurial classes at universities or to let

[11] The educated founder can be more successful because highly qualified employees enlarge the benefit of his own investments in Human Capital - so the founder can profit of cascade effects of his knowledge. Moreover qualified jobs are created on a long term perspective.

students gain practical experiences during their studies so they might have at the end of their study knowledge to reach both – success in an entrepreneurial career or in a dependent employment. This kind of academic education takes already place in the United States and more and more in European universities as well. As the examples in the United States and other nations show, this educational approach seems to be successful.

An upcoming study will discuss the impact of human capital gained in different kinds of universities and faculties on the employment decision of students and the entrepreneurial success of academic start-ups.

## References


Aiken, L.S.; West, S.G. (1991): Multiple regression: testing and interpreting interactions. Newbury Park (CA), London, New Dehli.

Albach, H. (1999): Unternehmensgründungen in Deutschland. In: Hahn, D.; Esser, K. (Hrsg.): Unternehmensgründungen – Wege in die Selbständigkeit, Chancen für innovative Unternehmen. Stuttgart, p. 1 - 14.

Almus, M.; Nerlinger, E.A (1999): Wachstumsdeterminanten junger innovativer Unternehmen: Empirische Ergebnisse für West-Deutschland. In: Jahrbücher für Nationalökonomie und Statistik 218, p. 257-275.

Almus, M. (2000): What Characterizes a Fast Growing Firm? ZEW-Discussion Paper 2000-64.

Audretsch, D.B. (1996): New Firms and Creating Employment. WZB Discussion Papers FSIV 96-7. Berlin.

Backes-Gellner, U.; Freund, W. ;Kay, R.; Kranzusch, P. (2000): Wettbewerbsfaktor Fachkräfte. Rekrutierungschancen und –probleme von kleinen und mittleren Unternehmen. Schriften zur Mittelstandsforschung, NF85. Bonn.

Bates, T. (1990): Entrepreneur human capital inputs and small business longevity. In: The review of Economics and Statistics 72(1990)4, p. 551-559.

Becker, G.S. (1962): Investment in Human Capital: A Theoretical analysis. In: Journal of Political Economy. 70(1962)5 part 2 supplement, p. 9-49.

Becker, G.S. (1993/1964): Human Capital – A Theoretical and Empirical Analysis with Special Reference to Education. 3rd ed. Chicago, London.

Birch, D.L. (1979): The job generation process. MIT program on neighborhood and regional change. Cambridge, MA.

Birch, D.L. (1987): Job Creation in America. How our smallest companies put the most people to work. New York.

Boston Bank (1998): MIT - Regional advantage. Boston.

Brüderl, J.; Preisendörfer, P.; Ziegler, R. (1992): Survival chances of newly founded business organizations. In: American Sociological Review 57, p. 227-242.

Brüderl, J.; Preisendörfer, P.; Ziegler, R. (1996): Der Erfolg neu gegründeter Betriebe – Eine empirische Studie zu den Chancen und Risiken von Unternehmensgründungen. Betriebswirtschaftliche Schriften. Band 140. Berlin.

Bühl, A.; Zöfel, P. (2000): Einführung in die moderne Datenanalyse unter Windows. München, Boston.
Cohn, M., Geske, P. (1990): Passing the torch: Transfer strategies for your family business. Blue Ridge Summit, Pa.
Davisson, P. (1989): Continued entrepreneurship and small firm growth. Stockholm.
Falk, M.; Koebel, B. (1998): Determinanten der qualifikatorischen Arbeitsnachfrage in der westdeutschen Industrie 1978 – 1990. In: Pfeiffer, F.; Pohlmeier, W. (Hrsg.): Qualifikation, Weiterbildung und Arbeitsmarkterfolg. ZEW Wirtschaftsanalysen, Schriftenreihe des ZEW, Bd. 31. Baden-Baden.
Ferligoj, A.; Prašnikar, J.; Jordan, V. (1997): Competitive advantage and human resource management in SMEs in a transitional economy. In: Small Business Economics, 9(1997), p. 503-514.
Fox. G. (1997/1947): Applied regression analysis, linear models, and related methods. London, New Dehli.
Gimeno, J.; Folta, T.B.; Cooper, A.C.; Woo, C.Y. (1997): Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms. In: Administrative Science Quaterly, 42(1997)Dec., p. 750-783.
Goebel, P. (1990): Erfolgreiche Jungunternehmer. Welche Fähigkeiten brauchen Firmengründer. München.
Hamermesh, D.S. (1999): The art of labor economics. National Bureau of economic Research – NBER working paper no. 6927. Cambridge, MA.
Hinz, T. (1998): Betriebsgründungen in Ostdeutschland. In: SAMF Sozialwissenschaftliche Arbeitsmarktforschung, NF Band 5. Berlin.
Holtz-Eakin, D., Joulfaian, D.; Rosen, H.S: (1994): Entrepreneurial decisions and liquidity constraints. In: RAND Journal of Economics, 25(1994)2, p. 334-347.
Holtz-Eakin, D.; Rosen, H.S.; Weathers, R. (2000): Horatio Algers meets the mobility tables. NBER Working Paper, No. 7619,03/2000. Cambridge (MA).
Joos, T. (1987): Unternehmensgründungen aus wirtschaftspolitischer Sicht. Europäische Hochschulschriften, Reihe V. Band 773. Frankfurt am Main.
Keeble, S.P. (1992): The ability to manage. Manchester, New York.
Klandt, H. (1984): Aktivität und Erfolg des Unternehmensgründers. Eine empirische Analyse unter Einbeziehung des mikrosozialen Umfeld. Berg.-Gladb.
Kulicke, M. (1987): Technologieorientierte Unternehmen in der Bundesrepublik Deutschland: Eine empirische Untersuchung der Strukturbildungs- und Wachstumsphase von Neugründungen. Frankfurt.
Leicht, R.; Philipp, R. (1999): Der Trend zum Ein-Personen-Unternehmen. Mehr Selbstbeschäftigte: Abschied vom "Normal-Unternehmer"? Arbeitspapier des IfM Manheim.
Lessat, V.; Woywode, M. (2001): Les facteurs de succès d'entreprises à croissance rapide en Allemagne. Revue Internationale PME, 17(2001)4, p. 15-40.
Machlup, F. (1984): The economics of information and human capital. In: Knowledge: Its creation, distribution and economic significance. Vol. III. Princeton.

Milius, F.; Zimmermann, V. (2000): Intellectual capital - Management mit neuen Medien. In: CoPers 3/2000, p. 34-37.
Mincer, J. (1974): Schooling, experience and earnings. New York.
Mincer, J. (1993): Studies in Human Capital. Collected Essays of Jacob Mincer. Vol. I. Aldershot.
Murphy, K.M.; Shleifer, A.; Vishny, R.W. (1991): The allocation of talent: implications for growth. In: Quarterly Journal of Economics 106(1991), p. 530 – 530.
Nagel, A. (1997): Personalarbeit und Unternehmenserfolg in der Rezession: Zur Bedeutung der Mitarbeiterinteressen. München.
Nerlinger, E.A. (1998): Standorte und Entwicklung junger innovativer Unternehmen. Baden-Baden.
Pett, A. (1993): Technologie- und Gründerzentren: Empirische Analyse eines Instrumentes zur Schaffung hochwertiger Arbeitsplätze. Europäische Hochschulschriften, Reihe V, Band 1508. Mainz.
Pfeiffer, F.; Falk, M. (1999): Der Faktor Humankapital in der Volkswirtschaft. In: Schriftenreihe des Zentrum für Europäische Wirtschaftsforschung ZEW, ZEW Wirtschaftsanalysen. Bd. 35. Mannheim.
Pfeiffer, F.; Reize, F. (2001): Formelle und informelle berufliche Weiterbildung und Verdienst bei Arbeitnehmern und Selbständigen. In: Robert K. von Weizsäcker (Hrsg.): Bildung und Beschäftigung. Schriften des Vereins für Socialpolitik Bd. 284. Berlin, p. 215 - 273.
Poensgen, O.H. (1982): Der Weg in den Vorstand. Die Charakteristiken der Vorstandsmitglieder der Aktiengesellschaften des Verarbeitenden Gewerbes. In: Die Betriebswirtschaft, 42(1982), p. 3.25.
Reynolds, P.D.; Miller, B.; Maki, W.R. (1995): Explaining regional variation in business birth and death: US 1976-1988. In: Small Business Economics, 1(1995), p. 181-191.
Ripsas, S. (1997): Entrepreneurship als ökonomischer Prozess. Perspektiven zur Förderung unternehmerischen Handelns. Wiesbaden.
Rosen, S. (1982): Authority, control, and the distribution of earnings. In: Bell Journal of Economics, 13(1982), p. 311 – 323.
Rosen, S. (1988): Promotions, elections and other contests. In: Journal of Institutional and Theoretical Economics (JITE), 144(1988), p. 73 – 90.
Saxenian, A. (1995): Culture and competition in Silicon Valley and Route 128. Cambridge/Harvard, MA.
Schefzyk, M. (2000): Finanzieren mit Venture Capital. Stuttgart.
Sexton, D.L.; Pricer, R.W.; Nenide, B. (2000): Measuring performance in high growth firms. Babson College – Frontiers of Entrepreneurship. Boston.
Sigal, Quince & Partners (1985): The Cambridge phenomenon. The growth of high technology industry in a university town. Cambridge, London.
Storey, D.J. (1994): Understanding the small business sector. London.
Szyperski, N.; Nathusius, K. (1977): Probleme der Unternehmensgründung: Eine betriebswirtschaftliche Analyse unternehmerischer Startbedingungen. Stuttgart.

Thome, H. (1991): Modelling and testing interactive relationships within regression analysis. In: Historical Social Research, 16 (1991)16, p. 21 – 50.
Wanzenböck, H. (1998): Überleben und Wachstum junger Unternehmen. Wien.